Original Communication

Anthropometric and anthroposcopic analysis of different shapes of faces in group of Indian population: A pilot study

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ABSTRACT

Focus of facial identification research is to isolate features that can be considered a factor of individualization. Anthropometry and Anthroposcopy have been the most important research tools in the field of forensic anthropology. These two methods of observation and data collection are made both on the living and on skeletonized human remains. Anthropometry is a systematic study of human measurements. Morphological analysis of unmeasurable features usually is the area of anthroposcopy. Hence, this study aims to assess different human faces using anthropometry and anthroposcopy. A total of 100 subjects were included in the study, prosopic index given by Martin and Saller was used to classify facial types. An anthropometric measurement was used to assess the facial proportions and anthroposcopy for facial morphology. A significant number of subjects were of hyperleptoprosopic facial type, and with a significant sexual dimorphism observed among the Indian population. Anthroposcopic analysis showed common morphological features in each prosopic indices. The findings in our study may throw light on anthropometric and anthroposcopic features of Indians and help significantly in the field of forensic anthropology.

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1. Introduction

The demography of India is remarkably rich with diverse historical background, which comprises one-sixth of the world's population. Furthermore it is a unique blend of different cultures, religions, beliefs and ideas. India is a home to one of the oldest civilization, which has laid the foundation for the development of multifaceted societies, resulting in a variety of complex forms of individuals.

Several information systems have evolved in the collection of data of people but always faced with a unique set of challenges. In order to reliably associate data with any particular type of individuals, it has become necessary that an effective and efficient identification scheme be developed, established and maintained. Personal identity is a distinctive feature that recognizes an individual, which makes one unique and different from others.

The human face is a reflection of uniqueness of a person. There can be hints to many aspects of the persona namely personality, temperament, overall health and levels of stress. Biologically, the facial phenotype is a product of genetics and environment that reflects features of populations in specific regions. Hence face is a dynamic structure that can transmit a wide range of expression from very minute to greatly exaggerated. Even the most subtle changes in expression may create different perception in others.

A primary focus of facial identification research is to isolate features that can be considered as factors of individualization. It is true that while populations share some obvious general attributes, everyone has same features that make him or her distinctive. It is these features that we rely upon in our everyday lives to identify and recognize each other, even though we may not be consciously aware of the process.[1]

Anthropometry and Anthroposcopy have been the most important research tools in biological and forensic anthropology. These two methods of observation and data collection can be employed both on the living and on skeletonized human remains. In essence, anthropometry is a systematic study of human measurements. Morphological analysis of unmeasurable features however usually falls into the area of anthroposcopy.[2] The use of anthropometry, in the field of forensic science and medicine dates back to 1882 by Alphonse Bertillon, a French police expert who devised a system of

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Table 1
Classification of facial types according to Martin and Saller.

Facial Type	Range of Prosopic index	Facial Skeleton
Mesoprosopic	84.0–87.9 mm	Average Facial skeleton
Euryprosopic	79.0–83.9 mm	Low facial skeleton
Hypereuryprosopic	<78.9 mm	
Leptoprosopic	88.0–92.9 mm	High facial skeleton
Hyperleptoprosopic	>93.0 mm	

criminal identification based on anthropometric measurements.[3] The human body dimensions are affected by ecological, biological, geographical, racial, **sex** and age factors. Inspite of all these variations, the human face is a distinct criterion for identification.[4] Hence, the aim of the present study is to analyze the different human faces with the help of anthropometry and anthroposcopy among Indian population.

2. Materials and methods

After obtaining the institutional ethical clearance and informed written consent, a total number of 100 Indian subjects, 50 females and 50 males aged between 19 and 35 years were included in the study. The exclusion criteria considered in the study were post operative head and face injuries, obvious baldness, congenital abnormal profile and post orthodontic treated cases.

For each individual a prosopic/facial index was calculated using the formula as given by Martin and Saller in Frontal view to determine the type of the face.[5]

$$\text{Prosopic index} = \frac{\text{Face length}}{\text{Face width}} \times 100$$

Face length was taken as the distance between nasion and gnathion and face width as the distance between the zygoma points. All these points were marked on the face with the subjects sitting on chair, in a relaxed condition and head in an anatomical position and measurements were taken manually by using DIGITAL CALLIPER, manufactured by Japan, product number is 150199, Accuracy of ±0.001.After calculating the prosopic index the facial types were classified as shown in Table 1. Similarly Anthropometric vertical measurements namely Trichion to Glabella, Nasion to pronasalae and Pronasalae to Pogonion (Fig. 2) and horizontal measurements
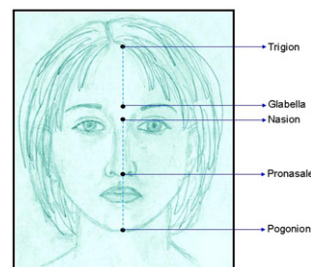
Fig. 2. Parameters considered for Anthropometric Vertical Dimensions of Face.
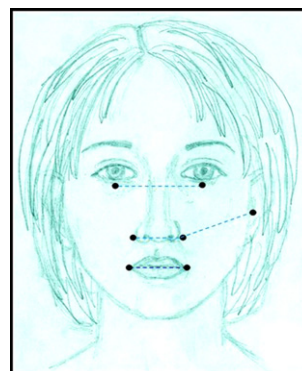
Fig. 3. Parameters considered for Anthropometric Horizontal Dimensions of Face.

namely interpupillary distance, alarae to alarae, chelion to chelion and alae to tragus were noted (Fig. 3), and also average of all these measurements were compared between the facial types. Anthroposcopic analysis was done for the commonly observed morphological characteristics of the face,[1] as shown in Fig. 1 and Table 2. Statistical analysis was done by using 'T' test for anthropometric measurements and chi square test for anthroposcopic features.

3. Results

Out of the 100 subjects from various states in India, majority of them were from Karnataka (17%), Maharashtra (15%) and Uttar
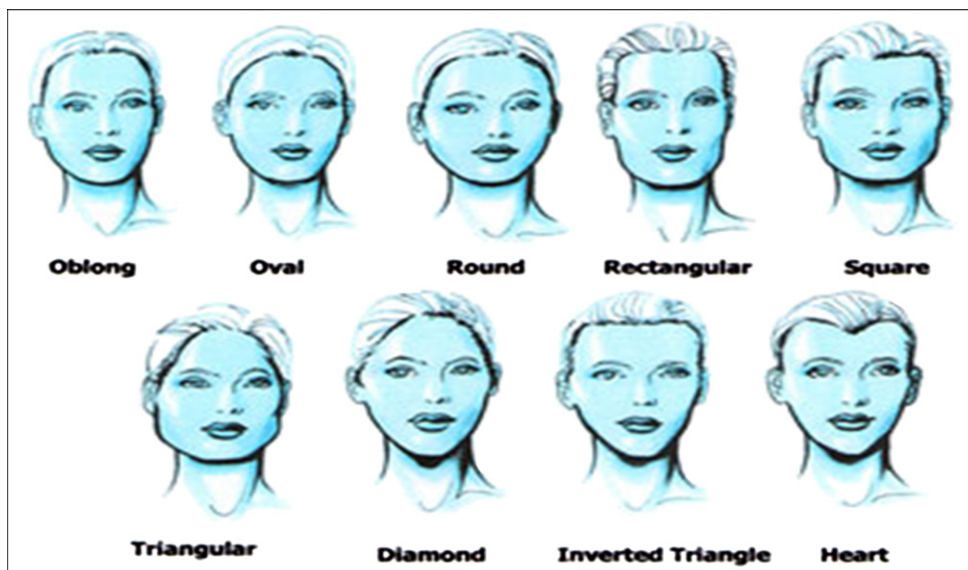

Fig. 1. Different shapes of faces commonly found.

Table 2
Anthroposcopic analysis for morphological characteristics of the face.

Shapes of Faces	Ablong, oval, round, rectangular, square, Triangular, diamond, inverted triangle, heart,
Shape of Forehead	Flat, protruding, steep.
Size of Nose	Normal (Length − 4–5 cm & alae to alae −3 to 3.5 cm) More than normal considered Macrorhinic Less than normal considered Microrhinic
Nasal contour	Straight, convex, concave, & crooked nasal bridge
Nasal tip shape	Normal, pointed, bilobed, angular, rounded.flat
Nasion depression	Trace, normal, deep, very deep
Lip thickness	Very thin − less than 1.5 cm Thin − 1.5 mm to 1.8 cm Average − 1.9 mm to 2.3 cm Thick − More than 2.3 cm
Philtrum Size	Small, wide
Philtrum Shape	Flat, deep, sides parallel, sides divergent
Mouth corner	Straight, upturn, down turn

Pradesh (14%) (Table, 3) After calculating the prosopic index for all the subjects 48% were Hyperleptoprosopic, 23% were Leptoprosopic, 15% mesoprosopic, 10% Euriprosopic and only 4% were of Hypereuriprosopic facial types as shown in Table 4 and Bar graph 1. On comparing the average measurements of all vertical and horizontal dimensions among the facial types, the average trigion to glabella, glabella to pronasalae and nasion to subnasalae were highest in hyperleptoprosopic facial type. The average pronasalae to pogonion distance was more in leptoprosopic, average interpupillary and alae to tragus distances were more in euriprosopic facial type. The average alae to alae and chilion to chilion dimensions were more in hypereuriprosopic facial type. In mesoprosopic all the measurements were comparatively less than the other facial types (Bar graph, 2). The vertical and horizontal measurements were compared between male and female subjects. The difference in trichion to glabella was 4 mm, pronasale to pogononion was 6 mm, nasion to subnasale was 2 mm but glabella to pronasalae was only 1 mm. The difference in interpupillary distance was 5 mm, alare to alare was 4 mm, ala to tragus was 7 mm. There was a statistically significant difference between them for all the measurements with 'p' value being 0.008 except glabella to pronasalae.

Among all the morphological characteristics which were observed for anthroposopy (Table, 2), the common features within

Table 3
Showing distribution of all subjects, according to states.

Sl. No.	State	Male	Female	Total
1.	Karnataka	6	11	17
2.	Andra Pradesh	5	2	7
3.	Tamil Nadu	0	1	1
4.	Kerala	0	1	1
5.	Gujarat	4	2	6
6.	Uttar Pradesh	7	7	14
7.	Bihar	1	3	4
8.	Madhya Pradesh	3	0	3
9.	Punjab	3	5	8
10.	Hariyana	2	1	3
11.	Maharashtra	6	9	15
12.	Delhi	4	2	6
13.	Goa	2	3	5
14.	Assam	1	0	1
15.	Orissa	2	0	2
16.	Rajasthan	1	1	2
17.	Jarkhand	1	1	2
18.	West. Bengal	2	0	2
19.	Meghalaya	0	1	1
		50	50	100

Among 100 subjects, major populations were from Karnataka − 17, Uttar Pradesh − 14 and Maharashtra − 15.

Table 4
Showing Prosopic index of all subjects.

|	Male	Female	Total
Mesoprosopic	8	7	15
Euriprosopic	7	3	10
Hypereuriprosopic	3	1	4
Leptoprosopic	12	11	23
Hyperleptoprosopic	20	28	48
Total	**50**	**50**	**100**

Majority of the subjects are of hyperleptoprosopic, i.e. 48 out of 100.

each classified facial types were obtained. Majority of the mesoprocopic were with square shape face, euriprosopic with heart shape face, hypereuriprosopic with round shape face, leptoprosopic and hyperleptoprosopic with oval shape face. The other commonly encountered features like size of the nose was microrhinic in euriprosopic, nasal contour was crooked in euriprosopic and hypereuriprosopic. Nasal tip shape was pointed in euriprosopic, nasion depression was very deep in hypereuriprosopic, mouth corner was straight in meso, lepto and hyperleptoprosopic, but down turn in euripro and hypereuriprosopic and double chin were observed only in euriprosopic facial type as shown in Table 5.

4. Discussion

In recent years, as the investigation of a crime scene has become more complex and sophisticated, so has the task of the forensic anthropologist. The forensic anthropologists have much to contribute to law enforcement and would welcome the opportunity to assist in the successful resolution of an investigation. The most common application of forensic anthropology in head and neck is to compare before and after death of dental photoimages.[6] Human physical variability has been a subject of interest for the scientist since a very long time.[7] For any person identification, the first focus is the face because the human face is a reflection of uniqueness of a person and is most attractive than any part of the body.[8]

Anthropometrical assessment is a scientific specialization concerned with the measurement to appreciate human size, shape, proportion, composition, maturation and gross function. This area has been defined as the quantitative interface between anatomy and physiology. It puts the individual into objective focus and provides a clear appraisal of his or her structural status at any given time.[9] Anthropometry of head and face is useful in designing various head and face equipments like helmets, head phone, goggles, etc by formulating standard sizes. So far many studies have
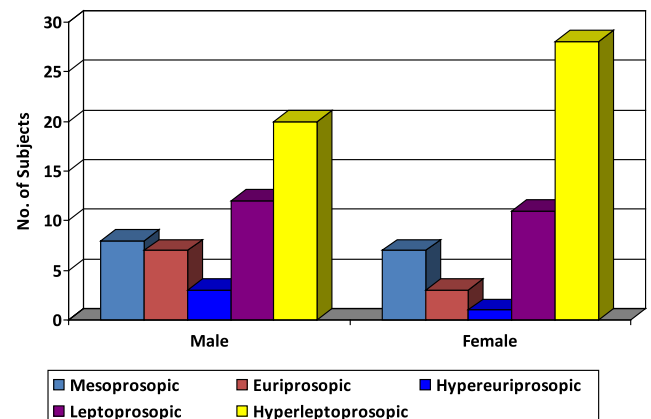
Bar graph 1. Sexual dimorphism of prosopic indices.

Bar graph 2. Distribution of highest anthropometric vertical and horizontal dimensions in prosopic indices.
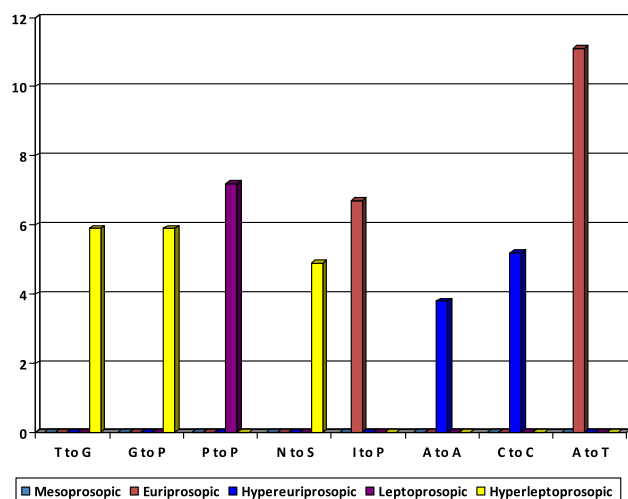
T to G	: Trichon to Glabella	I to P	: Interpupillary distance
G to P	: Glabella to pronasale	A to A	: Alare to Alare
P to P	: Pronasale to pogonion	C to C	: Chelion to Chelion
N to S	: Nasion to subnasale	A to T	: Alae to tragus

been conducted in various parts of India applying the techniques of anthropometry. Ethnologist classified Indian population on the basis of anthropometric data collected from various population of Indian subcontinent.[7] On the other side anthroposcopy is a system in assessing the variation of features in different population. The assessment criteria used in this technique are also at the root of anthropometry, that is anything that has a morphological variation can be observed with the naked eye and can also be measured.[9] As the face is a definitive element in identification, these systems can also be used in obtaining the common facial index, morphological features and sexual dimorphism in face in particular population to identify the victim in the field of crime.

Thus this study was aimed to assess different shapes of faces, by means of anthropometry and anthroposcopy among Indian population to obtain the common facial type, shape of face in all facial types with common morphological features in them which may assist forensic anthropologist, composite artist in personal identification. On anthropometric measurements majority of the Indian adults included in this study were hyperleptoprosopic facial types (48%). Golallapour et al, on studying the prosopic index in the 420 normal male new borns in the two races of fars and turkman groups

observed that the most dominant prosopic index was hyper-euriprosopic type among both the groups.[4]

The average four vertical and four horizontal measurements were compared between all the facial types. The average three vertical measurements namely trigion to glabella, glabella to pronasalae and nasion to subnasalae were highest in hyper-leptoprosopic facial type and the other vertical dimension pronasale to pogonion was highest in leptoprosopic. The majority of lepto and hyperleptoprosopic subjects had oval shape face. Hence by this observation it can be considered that the individuals with oval shape face will be either lepto or hyperlepto prosopic. Among the horizontal measurements the average interpupillary distance and alae to tragus was highest in euriprosopic with heart shape face and the other two alae to alae and chelion to chelion dimensions was highest in hypereuriprosopic with round shape face. Hence by this observation the individuals with either round or heart shape face can be considered as either euriprosopic or hypereuriprosopic, with highest horizontal dimensions.

The findings of the present investigation support the notion that metric values of females are smaller than those of males. The vertical and horizontal dimensions were highest in males than in females with statistically significant difference except glabella to pronasalae. Hence there is a definite sexual dimorphism among the Indian population in both the upper and lower third of face but the middle third of face showing lesser gender differences. Our study was not in accordance with the study of Vergilio F. Ferrario et al., on sexual dimorphism in human face by a Euclidean distance matrix analysis in 108 healthy young adults. They observed that the gender variations involved the middle and lower third of the face but upper part of face showing lesser gender differences. These findings can be related to the well known time differences in craniofacial growth, as males grow for a longer period of time and to a larger size than the females.[10]

Roland et al. conducted a study where they compared esthetic facial proportions of a group of randomly selected southern Chinese with the published ideal and average measurements for Caucasian women. They found that the face of Chinese women is different from the white face not only because the Chinese nose is less prominent, but also because of other important subtle differences in vertical and horizontal measurements.[11]

The question of racial affiliation is difficult to answer because although racial classification has some biological components, it is based primarily on social affiliation. Nevertheless, some anatomical details especially in the face, often suggests the individual race.[12]

Hence we conclude that the majority of Indian population in our study are Hyperleptoprosopic facial type with oval shape face and middle third of facial dimensions showed lesser gender variation. Thus obtaining the data of average measurements of all prosopic indices among Indian population and further having contributing morphological characteristics common in them may

Table 5
Common Anthroposcopic features of all Prosopic indices.

Prosopic index	Mesoprosopic	Euriprosopic	Hyper euripropic	Leptoprosopic	Hyperleptoprosopic
Shape of face	Square	Heart	Round	Oval	Oval
Forehead	Flat	Flat	Flat	Flat	Flat
Size of nose	Normal	**Macrorhinic**	Normal	Normal	Normal
Nasal contour	Straight	**Crooked**	**Crooked**	Straight	Straight
Nasal tip shape	Rounded	**Pointed**	Rounded	Rounded	Rounded
Nasion depression	Deep	Deep	**Very deep**	Deep	Deep
Lip thickening	Thin	Thin	Average	Thin	Average
Philrm size	Wide	Small	Small	Wide	Small
Philtrum shape	Sides parallel	**Flat**	**Flat**	Sides parallel	**Sides divergent**
Mouth corner	Straight	Down turn	Down turn	Straight	Straight
Chin shape	Normal	**Double chin**	Normal	Normal	Normal
Ear size	Large	Large	Large	Large	Large

help the forensic anthropologist in reconstructing facial appearance with the help of composite artist rendering sketches based on information supplied by eyewitness. It may also help in three-dimensional soft tissue build up of face on unidentified skulls, positively identifying the victims face by photographic superimposition and the plastic surgeons for facial reconstruction.

Efforts are still necessary for further studies for assessment of faces in all parts of India in a larger population and determining the role of environment, heredity, aging and racial factors on the shapes of faces.

Conflict of interest

None.

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None.

Ethical approval

Institutional ethical approval obtained.

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